92 The Nearest Star: The Sun

READING

Without the energy we receive from the Sun, Earth would be a cold, dark, and lifeless place. The Sun provides energy for the growth of plants that support life on Earth and the energy that drives the winds, ocean currents, and the water cycle.

Since ancient times, people have recognized the importance of the Sun as a source of warmth and light. The Sun played a central role in the myths of nearly every ancient culture. People observed the Sun in the sky and used its changing positions to predict seasonal events, such as when to plant and harvest crops.

CHALLENGE

How is the Sun different from other objects in the Solar System?

This 13th century temple in Konarak, Orissa, India is dedicated to the Sun God Surya.

READING

The Sun is a Star

Listen *as your teacher reads aloud.*

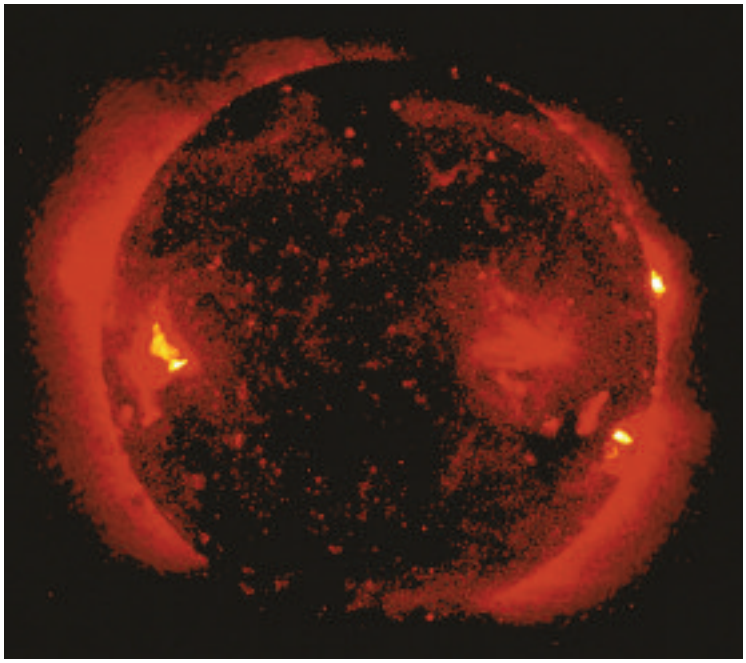
Stop *when you see this yellow pencil and close your book.*

Write *down the main ideas you just heard.*

Among the many billions of stars in our galaxy, the Sun is average in size and temperature. When you look at the night sky with your naked eye from anywhere on Earth, you can see up to 8,000 stars. With a telescope you will see many more. Still others can only be detected with other technologies. These have also helped astronomers learn about the composition of the Sun.

The Sun's composition is very different than that of Earth or the other planets, except Jupiter. It is mostly hydrogen and helium mixed together in a high-temperature gas. It varies from 5,000° C at the surface to more than 10,000,000° C at the center. Dark spots on the surface of the Sun, called sunspots, are a little cooler than the rest of the surface.

The Sun, like other stars, releases huge amounts of heat and light energy. This energy is produced by nuclear reactions at the Sun's center. A **nuclear reaction** involves a change in the nuclei (the center) of atoms. In the Sun, these nuclear reactions convert hydrogen to helium through a process known as nuclear fusion. In **nuclear fusion**, smaller atoms combine to form larger atoms. Nuclear fusion reactions release a very large amount of energy in comparison to other kinds of reactions. A hydrogen bomb, the most powerful type of nuclear bomb, uses nuclear fusion to produce more than enough energy to destroy an average sized city. Each second the Sun produces as much energy as millions of hydrogen bombs.



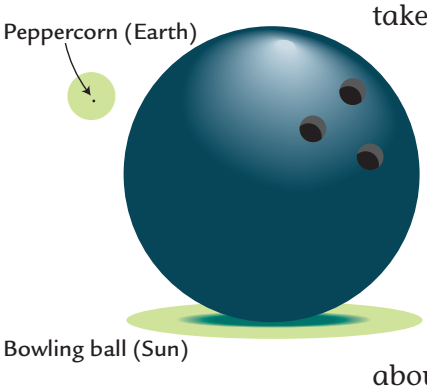
The Sun is the star that is closest to Earth.

The Sun has been producing energy from fusion for 5 billion years. When the hydrogen in the Sun, its nuclear fuel, runs out, it will stop releasing heat and light. But this won't happen anytime soon. The Sun is only about halfway through its 10-billion-year-long life cycle.

How Far and How Big?

If the Sun is an average-sized star, why does it appear so much larger than other stars? Because, of course, it is much closer. To imagine how much closer, you have to think in terms of very large numbers. The Sun is about 150 million km away from Earth, but our next closest star is more than *40 million million* km away or more than 250,000 times farther away.

That the Sun is about 150 million km away means it's far enough that it takes eight minutes for light to travel from the Sun's surface to Earth. If you traveled to the Sun in a regular passenger jet, the trip would take about 20 years!



The size of the Sun is hard to grasp, because it is almost never shown to scale in diagrams. Its diameter is about 1,390,000 km, almost 110 times that of Earth. More than one million Earths could fit inside the Sun. Even Jupiter, the largest planet, is only one-tenth the size of the Sun. If you use a peppercorn to represent Earth as shown at left, the Sun would be about the size of a bowling ball. Using this scale, you would have to place these items about 25 meters (the length of most public swimming pools) apart to show the distance between them.

A researcher in Antarctica sets up a recorder that measures the duration of sunlight.

The Sun at the Center

Today, scientists accept that the Sun is at the center of the Solar System. But early scientists thought that the Sun and other planets orbited Earth. In about 260 BCE, a Greek astronomer and mathematician named Aristarchus may have been the first to argue that Earth orbits the Sun. Most people ignored his ideas for a very long time because other well-known scientists did not accept them. Then, in the 1500s, Polish astronomer Nicolaus Copernicus noticed that he could not explain all his observations of planetary motion by using models with Earth at the center.

Copernicus realized that he could create a simpler model to explain his observations. In his model, shown below, you can see how it revived Aristarchus' idea that Earth and the other planets orbit the Sun. In the 1600s, the Italian astronomer Galileo used his telescope to make many observations that led him to support Copernicus' model. By 1700, most scientists agreed that the Sun was at the center of the Solar System. The model of the Solar System used today includes the planets circling the Sun, and also uses mathematical formulas to help predict the motion of the planets.

This drawing of Copernicus' model of the Solar System shows the Sun and the planets known at the time. It in written in Latin. Sol *means Sun and* Terra *means Earth.*

ANALYSIS

1. How would you explain to a fourth grader why the Sun looks so much bigger than other stars?

2. What is the source of the Sun's energy?

3. **a.** Is the following statement true or false?

   If you used an apple to represent the Sun, you would need to use a grape to represent Earth at the same scale.

   b. Explain your answer.

4. What characteristics of the Sun would make it a difficult place to explore or visit?

5. Why do you think it took a long time for people to accept that Earth and planets orbit the Sun?